

## Research Article

# Characteristics of junior high school teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning

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The teachers' beliefs in ethnomathematics-based numeracy learning are a crucial element to be able to develop students' numeracy skills. The teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning is a teacher's personal view about certain practices that are considered correct, which include four dimensions. The first dimension is the teachers' beliefs about numeracy. The second dimension is teachers' beliefs about the role of ethnomathematics in learning numeracy. The third dimension is teachers' beliefs about ethnomathematics-based numeracy teaching. The fourth dimension is teachers' beliefs about ethnomathematics-based numeracy learning. This study aimed to investigate the characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning. The teacher's response was acquired through the completion of a questionnaire. The findings indicated that most teachers believed fostering students' numeracy skills could be achieved by implementing ethnomathematics-based numeracy learning inside the semi-realistic-mechanistic (SRM) categories. Further analysis reveals that more extended teaching experience may mean something other than that a teacher has a realistically oriented outlook. Teachers with teaching experience of fewer than five years (new teachers) and 5 to 10 years (junior teachers) have a semi-realistic-mechanistic (SRM) view. Most teachers with more than 10 to 15 years (semi-senior-teachers) of teaching experience have a dominant realistic (DR) idea. In contrast, teachers with more than 15 years (senior teachers) of teaching experience have a semi-realistic-mechanistic (SRM) view and a dominant realistic (DR) view. Teachers' positive beliefs will likely improve students' numeracy skills in general and based on teaching experience in the dominant realistic (DR) and realistic (R) categories regarding ethnomathematics-based numeracy learning.

Keywords: Teachers' beliefs; Numeracy skills; Ethnomathematics

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## 1. Introduction

In recent decades, educational research has focused on teachers' beliefs (Aljaberi & Gheith, 2018; Diamond, 2019; Quigley, 2021; Russo et al., 2020; Schoen et al., 2019; Xie & Cai, 2021). Teachers' beliefs affect instruction (Bobis et al., 2016; Muhtarom et al., 2019; Pajares, 1992; Russo et al., 2020). Teachers' beliefs are crucial to promoting classroom teaching and education (Murugaiah, 2023).

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Multiple studies reveal a link between teachers' beliefs and instructional behaviors (Aljaberi & Gheith, 2018). Teachers' beliefs on context-based tasks do not help student learning (Wijaya et al., 2015). Other research suggests that teachers' beliefs affect anxiety about mathematics content and pedagogy (Peker & Ulu, 2018). The significance of teachers' beliefs in shaping teaching practice is noteworthy. This belief allows teachers to choose learning activities that meet their needs. Thus, the teachers' beliefs determine learning activities against students. If the teacher knows the students' abilities, they can adjust their behavior and education (Pajares, 1992).

The teacher will adapt their instructional strategies to accommodate the diverse requirements of students and align with advancements in science and technology. The exponential growth of scientific and technological advances presents a substantial challenge within education. Several study results show that in this 21st-century era, what is needed is not only the ability to understand concepts. Several critical aspects of dealing with needs in this modern era include applying concepts, higher-order thinking, and communication skills (Fadel, 2008; Forgasz, 2019; Dina et al., 2019; Tanujaya et al., 2017). These elements align with the goals of an international assessment program, specifically the Programme for International Student Assessment (PISA), which aims to evaluate individuals' capacity to apply their skills in diverse real-life contexts (Nugraheni & Marsigit, 2021; OECD, 2018). The PISA emphasizes examining practical issue scenarios and evaluating individual abilities to successfully transition into the workforce by possessing fundamental skills such as literacy and numeracy (OECD, 2018). Literacy and numeracy then became aspects measured by PISA, known as reading, mathematical, and scientific literacy.

The Indonesian government's Minimum Competency Assessment program mirrored the world's focus on numeracy and literacy. The Minimum Competency Assessment Program is used to assess the reading and numeracy skills of Indonesian students by solving problems in various contexts (Wijaya & Dewayani, 2021). Numeracy involves using mathematical concepts and skills to tackle everyday problems (Han et al., 2017). In all areas, students must employ math in real-world situations to develop numeracy (Goos et al., 2014). Numeracy skills enable students to respond to concerns they have or have never faced using mathematics as a basis for making decisions and solving problems. Problem-solving skills, critical thinking, and context understanding are required in numeration. Students with numeracy skills will be able to absorb information from the problems presented, sort the information needed, apply concepts to solve problems, familiarize themselves with identifying solutions to a problem, and interpret or interpret the solutions that have been obtained.

Developing numeracy skills is essential for students to successfully solve and overcome the various problems encountered in their daily lives. Students' numeracy skills can be developed by engaging in learning activities. By incorporating cultural artifacts and resources in the student's local environment, the teacher can effectively facilitate the improvement of numeracy skills. Teachers can develop instructional approaches incorporating ethnomathematics as a foundational framework for learning. According to (D'Ambrosio, 2001), ethnomathematics is a conduit between mathematics and culture. Traditional Javanese games have been identified as a potential cultural resource for enhancing numeracy skills in educational settings. Researchers such as (Prahmana et al., 2012; Risdiyanti et al., 2018; Wijaya, 2008; Wijaya et al., 2018) have highlighted the capacity of traditional Javanese game activities to serve as effective models for the acquisition and application of mathematical concepts.

There are many studies on teachers' beliefs about mathematics teaching practices. The study on mathematics teachers shows that teachers' beliefs as the center of mathematics learning and developing problem-solving skills are very positive (Russo et al., 2020). The study conducted with mathematics teachers' subjects shows that teachers' beliefs tend toward views on teaching and learning mathematics that encourage students to be actively involved in solving problems in various contexts (Wijaya et al., 2015). The study of 101 teachers showed that teachers' beliefs about teaching and learning mathematics leaned more towards constructive or mixed (Aljaberi & Gheith,

2018). Teachers' beliefs and the quality of classroom teaching using problem-posing have implications for improving the effectiveness of professional development programs (Li et al., 2022). However, no study has examined teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning. Thus, this study is crucial to understanding teachers' beliefs in ethnomathematics-based numeracy learning to increase learning. This study will examine teachers' beliefs about ethnomathematics-based numeracy learning. This study is crucial philosophically and practically. First, the exploration results summarise teachers' ideas for strengthening students' numeracy skills through ethnomathematics-based numeracy learning in general and based on teaching experience. Second, teachers can leverage their conviction in ethnomathematics-based numeracy learning to intervene and improve class numeracy learning.

### 1.1. Teachers' Beliefs

Teachers' beliefs are their opinions about correct topics or procedures (Russo et al., 2020). Teachers have views about teaching, learning, and curriculum (Shah, 2021). Math teachers' beliefs include instructional methods, student direction, problem-solving, and motivation. Teachers' learning beliefs are regarding students' learning roles (Muhtarom et al., 2019). The significance of teachers' beliefs in shaping teaching practice is essential. Teachers can choose learning activities based on student requirements using this belief. Thus, the teachers' beliefs determine learning activities against students. The teachers' beliefs system encompasses three key components: 1) their perspective on the inherent nature of mathematics; 2) the diverse teaching strategies and classroom activities employed to facilitate the instruction of mathematics; and 3) their outlook on the desired objectives, anticipated outcomes, conceptualizations, and depictions of the learning process in mathematics (Ernest, 2006).

Two characteristics of teacher teaching practices in mathematics education are the mechanistic and realistic approaches. The mechanistic approach is the teacher's orientation to mathematics as a computational problem and algorithmic concepts in solving mathematical problems to practice previously learned procedures. Meanwhile, the realistic approach is teaching mathematics that connects mathematics and its learning with real-life situations (van den Heuvel-Panhuizen, 2010; Wijaya et al., 2015). The following are the characteristics of teachers' beliefs based on teaching practice in Table 1.

Table 1

*Characteristics of teachers' beliefs based on teaching practices*

<i>Teachers' beliefs</i>	
<i>Mechanistic</i>	<i>Realistic</i>
a) Computational problem-solving and algorithms for executing previously studied techniques are taught to math teachers.	a) The teaching of mathematics establishes connections between mathematical concepts and their application in practical, real-life situations.
b) The main focus in this teaching practice is solving problems with standard procedures that the teacher has practiced and applying mathematics to word problems.	b) The challenges presented to students serve as a pedagogical instrument aimed at facilitating students' engagement with real-world scenarios and fostering the cultivation of profound mathematical thinking.
c) This teaching focuses on practicing applying mathematical procedures without being linked to the context of the problem.	c) The provided challenges allow students to generate models, investigate and establish connections between mathematical techniques or concepts, and discern pertinent information to resolve problems.
d) The problems presented have straightforward questions and contain only relevant information to solve the problem.	

*Note.* Adapted from van den Heuvel-Panhuizen, 2010; Wijaya et al., 2015.

## 1.2. Numeracy

Numeracy encompasses an individual's ability to utilize mathematical knowledge to analyze phenomena, solve problems, and make informed decisions in everyday life (Wijaya & Dewayani, 2021). Moreover, numeracy may be defined as the aptitude to utilize mathematical principles and competencies to address pragmatic issues inside diverse spheres of daily existence (Han et al., 2017). Developing numeracy skills necessitates students' active involvement in and practical application of mathematical concepts in various real-world contexts across several academic domains (Goos et al., 2014). The scope of numeracy extends beyond the mere execution of numerical operations, encompassing a broader domain of conceptual mastery and mathematical reasoning skills (Cockcroft, 1982). Thus, numeracy entails effectively comprehending mathematical concepts and the capacity to employ them (Wijaya & Dewayani, 2021).

Numeracy refers to the cognitive capacity to analyze and interpret quantitative data in diverse formats, such as graphs, tables, and charts. It encompasses utilizing the insights derived from this analysis to make predictions and informed decisions (Han et al., 2017). Numeracy skills include activities that entail counting and are fundamental to participants' interactions and interpretation process. These skills extend beyond mere numerical activity and encompass a broader conceptual framework that imbues these activities with meaning (Baker, 2003). Numeracy skills will involve more than just mastering basic mathematics. However, they can link mathematics material studied at school with situations outside of school, which also require problem-solving and critical assessment in non-mathematics (Susanto et al., 2021).

For students to become numerate, emphasis must be given to mathematical reasoning as a core aspect of numeracy and realized through the following problem-solving process (OECD, 2018).

- **Formulate:** At this stage, students endeavor to identify elements of contextual issues that can be conceptualized and expressed in a mathematical format for resolution.
- **Employ:** At this stage, students actively employ concepts, facts, procedures, and mathematical reasoning in order to address issues and deduce conclusions, thereby pursuing mathematical solutions.
- **Interpret and Evaluate:** At this stage, students can participate in reflective thinking while considering mathematical solutions, results, or conclusions and interpreting them in real-world circumstances. This process aids in the integration of these mathematical concepts into problem-solving activities. This process entails converting mathematical answers or logical reasoning into the original problem's context, followed by assessing the coherence and applicability of the obtained outcomes within the problems' framework.

According to this description, numeracy refers to an individual's capacity to identify elements of contextual problems that can be abstracted and represented mathematically. It involves employing suitable strategies, applying mathematical concepts and skills to resolve problems, and critically analyzing mathematical solutions by relating them to real-life situations. This procedure entails utilizing problem-solving methodologies and assessing mathematical solutions within the framework of real-world complexities.

## 1.3. Ethnomathematics

Ethnomathematics is an academic discipline investigating the intersection of culture and mathematics (D'Ambrosio, 2001). Students' ideas, strategies, and practices are used to conceive, generalize, and apply many information sources to portray real-world problems in varied circumstances in ethnomathematics (Rosa & Orey, 2015). Students can better understand complex concepts and solve problems with ethnomathematics (Amit & Abu Qouder, 2017; Owens, 2014). Numerous ethno-mathematics studies (Astuti et al., 2019; Muhtadi et al., 2017; Supiyati & Hanum, 2019) demonstrate its ability to expose mathematical concepts in cultural activities or school maths learning environments.

The ethnomathematics of Sasak cultural architecture, such as residential dwellings (Bale), religious buildings (mosques), and barns ("sambi"), include mathematical principles (Supiyati &

Hanum, 2019). According to the study, Sundanese ethnomathematics involves estimating, measuring, and constructing patterns (Muhtadi et al., 2017). Research on ethnomathematics in math learning (Jaelani et al., 2013; Prahmana et al., 2012; Wijaya et al., 2011) shows that traditional games can help students understand arithmetic ideas. Research shows traditional Indonesian games can assist linear measurement learning (Wijaya et al., 2011). Other research has shown that the Traditional Illustrated Tap Game (PT2B) can assist kids in comprehending multiplication (Prahmana et al., 2012).

#### **1.4. Teacher's Belief in Ethnomathematics-based Numeracy Learning**

The teachers' beliefs in ethnomathematics-based numeracy learning in this study have some aspects. First, teachers' beliefs about numeracy contain their viewpoints of individual's capacity to proficiently employ mathematical concepts and skills to tackle real-world challenges in various contexts. Second, the teachers' beliefs about the role of ethnomathematics in learning numeracy, namely the teacher's view/assessment that ethnomathematics in learning numeracy is meaningful (essential), namely as a means of discovering mathematical concepts. Third, teachers' beliefs about ethnomathematics-based numeracy teaching, namely teachers' assumptions/assessments regarding planning and various teaching actions that will support students in discovering mathematical concepts and implementing mathematical concepts in solving contextual problems independently. Finally, teachers' beliefs about ethnomathematics-based numeracy learning include their descriptions of student learning activities, everyday life experiences, skill mastery, and mental activity in learning that supports numeracy.

#### **1.5. The Aim**

This study aims to ascertain the characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning, as evidenced by the existing body of literature. The questioning consists of two questions:

RQ 1) What are the general characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning?

RQ 2) What are the characteristics the teachers' beliefs in developing of numeracy skills through ethnomathematics-based learning based on teaching experience?

## **2. Method**

### **2.1. Research Design**

A survey research study was undertaken to examine teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning. The study employed both a printed questionnaire and a web-based questionnaire in the form of a Google form. This study serves the purpose of addressing both questions.

### **2.2. Participants**

This study involved the participation of mathematics teachers from public and private junior high schools in three districts in Central Java, Indonesia. The population in this study was 537 junior high school mathematics teachers. This study used purposive sampling techniques. One hundred fifty-one mathematics middle school teachers, 114 public middle school teachers, and 37 private middle school teachers were used as research samples. The purposive sampling technique, alternatively referred to as judgmental sampling, involves a purposeful selection process that specific characteristics possessed by the participants guide (Etikan, 2016). The reason for using purposive sampling in this research is to focus on a population with specific characteristics of concern. The criteria for respondents for selecting this research were teachers who were active in subject-teacher deliberation activities.

The teachers in the sample demonstrated a wide range of teaching experiences. Specifically, 47 teachers reporting having less than five years of experience were called new teachers, 14 teachers reporting having between 5 and 10 years of teaching experience were called junior teachers, 12

teachers reporting having between 10 and 15 years of experience were called semi-senior teachers, and 78 teachers reporting having 15 or more years of experience were termed senior teachers. Most teachers in this research have a bachelor's degree in mathematics education, while a few have a master's degree. The characteristics of the individuals involved in this study are presented in Table 2.

Table 2

*Characteristics of research participants (n = 151)*

	<i>Frequency</i>	<i>Percentage (%)</i>
School		
Public	114	75.5
Private	37	24.5
Teaching experience		
New teachers (< 5 years)	47	31.1
Junior teachers (5 ≤ years ≤ 10)	14	9.3
Semi-senior teachers (10 < years ≤ 15)	12	7.9
Senior teachers (> 15 years)	78	51.7

### 2.3. Teachers' Beliefs Questionnaire

Information on teachers' beliefs about developing numeracy skills through ethnomathematics-based learning was collected using a questionnaire of 4 dimensions. The first dimension is the dimension of teachers' beliefs about numeracy. The second dimension is teachers' beliefs about the role of ethnomathematics in learning numeracy. The third dimension is teachers' beliefs about ethnomathematics-based numeracy teaching. The fourth dimension is teachers' beliefs about ethnomathematics-based numeracy learning. The dimensions of teachers' beliefs about numeracy are broken into six statements. The dimensions of teachers' beliefs about the role of ethnomathematics in learning numeracy are broken down into six statements. The dimensions of teachers' beliefs about ethnomathematics-based numeracy teaching are broken down into four statements. The dimensions of teachers' beliefs about ethnomathematics-based numeracy learning are broken down into four statements. This questionnaire was adapted from the teachers' beliefs measuring tool questionnaire, which measures teachers' beliefs in mathematics learning (Wijaya et al., 2015), and the mathematics teachers' beliefs scale (MTBS) instrument was subjected to exploratory factor analysis (EFA) to assess the questions' alignment with their intended purpose. Confirmatory factor analysis (CFA) was also conducted to finalize the instrument (Xie & Cai, 2021). This questionnaire was chosen because it is relevant to the scale that will be measured in this study. Participants must obtain responses to each statement to obtain an overview of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning.

This study applies Aiken's V method (Aiken, 1985) to establish content validity, as the content validity coefficient indicates the content validity coefficient. The calculation of the content validity coefficient is derived from the evaluations of three experts regarding an item. This procedure assesses the degree to which the items can accurately represent the underlying concept being measured accurately. Experts evaluate each topic using a Likert scale ranging from 1 to 5. An item meets valid requirements if its Aiken's V coefficient exceeds 0.75 (Aiken, 1985). The findings of the content validity analysis indicated that Aiken's V value for developing students' numeracy skills using an ethnomathematics-based numeracy learning scale was 0.92, surpassing the threshold of 0.75, which is considered valid according to established criteria.

The validation results presented by experts indicate that the items within the teachers' beliefs questionnaire instrument can assess each aspect of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning. Hence, this tool is deemed appropriate for evaluating teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning. Following expert validation, the instrument was

subsequently employed to gather data about teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning.

Furthermore, a 4-point scale was used to measure teachers' beliefs from strongly agree, agree, disagree, and strongly disagree, with a score of 1 to 4. Statements P1, P5, P8, P13, P17, and P19 measure teachers' beliefs about numeracy. This study aims to ascertain the origins of teachers' beliefs towards numeracy, specifically whether they are derived solely from a comprehension of mathematical principles or influenced by the application of mathematical concepts in real-world scenarios. The teacher must exhibit the cognitive processes associated with comprehending the importance of ethnomathematics in learning numeracy skills, as stated in P4, P9, P12, P15, P18, and P20. In particular, we wanted to find out whether teachers' beliefs about ethnomathematics in learning numeracy had a role as entertainment (decorative), namely as a distraction in learning numeracy, or meaningful (essential) as a means of discovering mathematical concepts. Statements P3, P6, P11, and P16 are intended to measure teachers' beliefs in ethnomathematics-based numeracy teaching related to planning and various teaching actions that will support students in discovering mathematical concepts and implementing concepts in solving contextual problems independently. Then, statements P2, P7, P10, and P14 are used to measure teachers' beliefs in ethnomathematics-based numeracy learning related to learning activities carried out by students, students' experiences in everyday life, mastery of skills, and students' mental activity in learning that is support numeracy skills.

Teachers who consistently respond with "strongly agree" or "agree" to statements that align with a realistic perspective and consistently respond with "disagree" or "strongly disagree" to claims that align with a mechanistic perspective can be considered as holding a Realistic (R) view. Teachers who consistently answer "strongly agree" or "agree" to most statements supporting the realistic point of view while answering "disagree" or "strongly disagree" to several statements that support the mechanistic point of view can be classified as teachers who have a Dominant Realistic (DR) view. If a teacher responds with "strongly agree" or "agree" to statements that promote a realistic perspective and responds with "disagree" or "strongly disagree" to statements that promote a mechanistic perspective in equal measure, then the teacher can be said to hold a Semi-Realistic-Mechanistic (SRM) view. If a teacher consistently responds with "strongly agree" or "agree" to statements that promote a realistic perspective and consistently responds with "disagree" or "strongly disagree" to claims that promote a mechanistic perspective, it might be inferred that the teacher holds a Dominant Mechanistic (DM) view. If a teacher consistently responds with "strongly agree" or "agree" to statements that promote a mechanical perspective and consistently responds with "disagree" or "strongly disagree" to claims that support a realistic perspective, it can be inferred that the teacher holds a Mechanistic (M) view.

#### **2.4. Data Analysis**

The study's data was subjected to both quantitative and qualitative examination. Quantitative data analysis entails the utilization of Microsoft Excel software for data processing, which is afterward presented in the form of percentages. The present study employed qualitative data analysis techniques to examine the characteristics of teachers' beliefs. The study employed the thematic analysis methodology, encompassing stages: familiarization with the data, first code generation, topic identification, theme review, theme establishment and labeling, and report generation (Braun & Clarke, 2006). The researcher conducted a comprehensive primary data analysis to establish a foundational comprehension of the questionnaire data. Subsequently, the researcher proceeded with the encoding of the submitted responses. The numerical scores were allocated to the responses of the research participants based on the rating scale supplied in the questionnaire. Once the code is provided, it is employed to ascertain a thematic representation elucidates the underlying tenets of the teacher's convictions. The applicability of each subject is assessed by the codes employed in the compilation of the theme (Minihan et al., 2022). The categorization framework utilized to classify teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning is presented in Table 3.

**Table 3**  
**Category framework for grouping teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning**

Category	Dimension		
	Teachers' Beliefs about Numeracy	Teachers' Beliefs about the Role of Ethnomathematics in Learning Numeracy	Teachers' Beliefs about Ethnomathematics-based Numeracy Teaching
Mechanistic (M)	Teachers have a weak belief that numeracy refers to an individual's capacity to utilize mathematical concepts and skills to effectively address and resolve practical difficulties encountered in diverse real-life situations.	Teachers have a weak belief that ethnomathematics in learning numeracy is meaningful (essential), namely as a means of discovering mathematical concepts.	Teachers have a weak belief that planning and various teaching actions will support students in discovering mathematical concepts and implementing mathematical concepts in solving contextual problems independently.
Mechanistic dominant (MD)	Teachers do not believe that numeracy is an individual's ability to apply mathematical concepts and skills and interpret them to solve everyday problems in various contexts.	Teachers do not believe that ethnomathematics in learning numeracy is meaningful (essential), namely as a means of discovering mathematical concepts.	Teachers do not believe that the learning activities carried out by students, students' experiences in daily life, mastery of skills, and students' mental activities in learning can support numeracy skills.
Semi-realistic-mechanistic (SRM)	Teachers have a moderate belief that numeracy is an individual's ability to apply mathematical concepts and skills and interpret them in solving daily life problems in various contexts.	Teachers have a moderate belief that ethnomathematics in learning numeracy is meaningful (essential), namely as a means of discovering mathematical concepts.	Teachers do not believe that the learning activities carried out by students, students' experiences in daily life, mastery of skills, and students' mental activity in learning can support numeracy skills.
Realistic dominant (RD)	The teacher believes that numeracy is an individual's ability to apply mathematical concepts and skills and make interpretations to solve everyday problems in various contexts.	Teacher believes that ethnomathematics in learning numeracy is meaningful (essential), namely as a means of discovering mathematical concepts.	The teacher believes that the learning activities carried out by students, students' experiences in daily life, mastery of skills, and students' mental activities in learning can support numeracy skills.
Realistic (R)	Teachers strongly believe that numeracy is an individual's ability to apply mathematical concepts and skills and interpret them to solve everyday problems in various contexts.	Teachers strongly believe that ethnomathematics in learning numeracy is meaningful (essential), namely as a means of discovering mathematical concepts.	Teachers strongly believe that the learning activities carried out by students, students' experiences in daily life, mastery of skills, and students' mental activities in learning can support numeracy skills.



Based on the teacher's belief categorization framework, the themes representing teachers' beliefs determined research subject's belief categories on each dimension (see Table 3). Utilizing the characteristics inherent in each dimension of teachers' beliefs, the final stage concludes the general belief categories of each research topic based on teaching experience.

### 3. Result

#### 3.1. Characteristics of the Teacher's Belief in Developing Students' Numeracy Skills through Ethnomathematics-based Numeracy Learning

The questionnaire data showed teachers' beliefs about numeracy, the role of ethnomathematics in learning numeracy, ethnomathematics-based numeracy teaching, and ethnomathematics-based numeracy learning. The teachers' beliefs about numeracy are generally semi-realistic-mechanistic (SRM). The teachers' beliefs about the role of ethnomathematics in learning numeracy are realistic (R). Teachers' beliefs about ethnomathematics-based numeracy teaching are semi-realistic-mechanistic (SRM). Teachers' beliefs about ethnomathematics-based numeracy learning are realistic (R).

##### 3.1.1. Teachers' beliefs about numeracy

The questionnaire data shows the following results regarding teachers' beliefs about numeracy. When teachers were asked about their views on numeracy, we found that almost 99% of teachers (150 out of 151) believe that numeracy could help students solve everyday life problems in various contexts. 91% of teachers (137 out of 151) believe that the main focus in numeracy is the ability to apply mathematics. Furthermore, 95% of teachers (143 out of 151) believe that numeracy emphasizes students' skills in implementing mathematical concepts.

However, 98% of teachers (148 out of 151) believe numeracy can help students solve formal math problems. More than 94% of teachers (143 out of 151) believe that the main focus in numeracy is understanding mathematical concepts. Then, more than 76% of teachers (115 out of 151) believe that numeracy places more emphasis on students' numeracy skills.

##### 3.1.2. Teachers' beliefs about the role of ethnomathematics in learning numeracy

The questionnaire data shows the following results regarding teachers' beliefs about the role of ethnomathematics in learning numeracy. 94% (142 out of 151) of teachers believe traditional Javanese games could be used as contexts in learning numeracy. More than 96% of teachers (145 out of 151) believe traditional Javanese games in learning numeracy can be used to discover mathematical concepts.

However, we found that more than 83% of teachers (125 out of 151) believe that the primary function of traditional Javanese games in learning numeracy was to serve as a distraction so that students would not get bored. Furthermore, more than 55% of teachers (83 out of 151) believe that using traditional Javanese games in learning numeracy made students focus on their game activities. As many as 83% (126 out of 151) teachers believe that the game rules contained in traditional Javanese games do not contain mathematical concepts. Less than 17% of teachers (25 out of 151) believe that using traditional Javanese games in learning numeracy keeps students focused on learning numeracy activities.

##### 3.1.3. Teachers' beliefs about ethnomathematics-based numeracy teaching

Regarding beliefs about ethnomathematics-based numeracy teaching, 92% of teachers (139 out of 151) believe that in traditional Javanese game-based numeracy learning, teachers facilitate opportunities for students to explore and uncover mathematical topics independently. However, as many as 59% of teachers (89 out of 151) believe that in learning numeracy, the teacher directly shows mathematical concepts related to traditional games. Furthermore, as many as 70% of teachers (105 out of 151) believe that to solve contextual problems in learning numeracy, the teacher makes sentences/mathematical models so students do not make mistakes. As many as 23%

of teachers (33 out of 151) believe that solving contextual problems in learning numeracy and making sentences/mathematical models is done by students.

### 3.1.4. Teachers' beliefs about ethnomathematics-based numeracy learning

Regarding beliefs about ethnomathematics-based numeracy learning, it shows views that can support learning activities. More than 98% of teachers (149 out of 151) believe that students' experiences in everyday life can be used to build numeracy skills. Furthermore, as many as 36% of teachers (55 out of 151) believe that strengthening numeracy skills was carried out through one subject, namely mathematics, and this was further strengthened by as many as 97% of teachers (147 out of 151) believe that strengthening numeracy skills could be carried out across subjects. However, as many as 85% of teachers (129 out of 151) believe that counting is the primary skill that must be mastered by students in learning numeracy based on traditional Javanese games. The characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning are determined based on the most significant percentage of respondents. Characteristics of teachers' beliefs about numeracy in developing students' numeracy skills through ethnomathematics-based numeracy learning are presented in Table 4.

Table 4

*Characteristics of teachers' beliefs about numeracy in developing students' numeracy skills through ethnomathematics-based numeracy learning*

Category	Frequency	Percentage (%)	Conclusion	Characteristics
Mechanistic (M)	0	0.0	Semi-realistic-mechanistic (SRM)	Teachers have a moderate belief that numeracy is an individual's ability to apply mathematical concepts and skills and interpret them in solving daily life problems in various contexts.
Mechanistic dominant (MD)	7	4.6		
Semi-realistic-mechanistic (SRM)	115	76.2		
Realistic dominant (RD)	29	19.2		
Realistic (R)	0	0.0		

The analysis results of teachers' beliefs about numeracy in developing students' numeracy skills through ethnomathematics-based numeracy learning are in the SRM category. The characteristics of the SRM category are that teachers have a moderate belief that numeracy is an individual's ability to apply mathematical concepts and skills and interpret them in solving daily life problems in various contexts.

Characteristics of teachers' beliefs about the role of ethnomathematics in learning numeracy in developing students' numeracy skills through ethnomathematics-based numeracy learning are presented in Table 5.

Table 5

*Characteristics of teachers' beliefs about the role of ethnomathematics in learning numeracy in developing students' numeracy skills through ethnomathematics-based numeracy learning*

Category	Frequency	Percentage (%)	Conclusion	Characteristics
Mechanistic (M)	0	0.0	Semi-realistic-mechanistic (SRM)	Teachers have a moderate belief that ethnomathematics in learning numeracy is meaningful (essential), namely as a means of discovering mathematical concepts.
Mechanistic dominant (MD)	10	6.6		
Semi-realistic-mechanistic (SRM)	71	47.0		
Realistic dominant (RD)	70	46.4		
Realistic (R)	0	0.0		

The results of the analysis of teachers' beliefs about the role of ethnomathematics in learning numeracy in developing students' numeracy skills through ethnomathematics-based numeracy learning are in the SRM category. The characteristics of the SRM category are that teachers have a moderate belief that ethnomathematics in learning numeracy is meaningful (essential), namely as a means of discovering mathematical concepts.

Characteristics of teachers' beliefs about ethnomathematics-based numeracy teaching in developing students' numeracy skills through ethnomathematics-based numeracy learning are presented in Table 6.

Table 6

*Characteristics of teachers' beliefs about ethnomathematics-based numeracy teaching in developing students' numeracy skills through ethnomathematics-based numeracy learning*

Category	Frequency	Percentage (%)	Conclusion	Characteristics
Mechanistic (M)	3	2.0	Semi-realistic-mechanistic (SRM)	Teachers have a moderate belief that designing and implementing diverse instructional strategies would effectively facilitate students' exploration of mathematical concepts and their ability to use these concepts to solve real-world situations independently.
Mechanistic dominant (MD)	12	7.9		
Semi-realistic-mechanistic (SRM)	70	46.4		
Realistic dominant (RD)	37	24.5		
Realistic (R)	29	19.2		

The analysis results of teachers' beliefs about ethnomathematics-based numeracy teaching in developing students' numeracy skills through ethnomathematics-based numeracy learning are in the SRM category. The characteristics of the SRM category are that teachers have a moderate belief that designing and implementing diverse instructional strategies would effectively facilitate students' exploration of mathematical concepts and their ability to use them to solve real-world situations independently.

Characteristics of teachers' beliefs about ethnomathematics-based numeracy learning in developing students' numeracy skills through ethnomathematics-based numeracy learning are presented in Table 7.

Table 7

*Characteristics of teachers' beliefs about ethnomathematics-based numeracy learning in developing students' numeracy skills through ethnomathematics-based numeracy learning*

Category	Frequency	Percentage (%)	Conclusion	Characteristics
Mechanistic (M)	0	0.0	Realistic dominant (RD)	The teacher believes that the learning activities carried out by students, students' experiences in daily life, mastery of skills, and students' mental activities in learning can support numeracy skills.
Mechanistic dominant (MD)	3	2.0		
Semi-realistic-mechanistic (SRM)	51	33.8		
Realistic dominant (RD)	81	53.6		
Realistic (R)	16	10.6		

The analysis results of teachers' beliefs about ethnomathematics-based numeracy learning in developing students' numeracy skills through ethnomathematics-based numeracy learning are in the RD category. The characteristics of the RD category are that the teacher believes that the learning activities carried out by students, students' experiences in daily life, mastery of skills, and students' mental activities in learning can support numeracy skills.

Characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning are presented in Table 8.

Table 8

*Characteristics of teachers' belief in developing students' numeracy skills through ethnomathematics-based numeracy learning*

<i>Dimension</i>	<i>Category</i>	<i>Characteristics</i>
Teachers' beliefs about numeracy	Semi-realistic-mechanistic (SRM)	Teachers have a moderate belief that numeracy is an individual's ability to apply mathematical concepts and skills and interpret them in solving daily life problems in various contexts.
Teachers' beliefs about the role of ethnomathematics in learning numeracy	Semi-realistic-mechanistic (SRM)	Teachers have a moderate belief that ethnomathematics in learning numeracy is meaningful (essential), namely as a means of discovering mathematical concepts.
Teachers' beliefs about ethnomathematics-based numeracy teaching	Semi-realistic-mechanistic (SRM)	Teachers have a moderate belief that designing and implementing diverse instructional strategies would effectively facilitate students' exploration of mathematical concepts and their ability to use these concepts to solve real-world situations independently.
Teachers' beliefs about ethnomathematics-based numeracy learning	Realistic dominant (RD)	The teacher believes that the learning activities carried out by students, students' experiences in daily life, mastery of skills, and students' mental activities in learning can support numeracy skills.

### **3.2. Characteristics of the Teacher's Belief in Developing Students' Numeracy Skills through Ethnomathematics-based Numeracy Learning based on Teaching Experience**

The questionnaire data provides insights into the characteristics of teachers' beliefs that are shaped by teaching experience. These beliefs encompass various dimensions, such as teachers' beliefs about numeracy, teachers' beliefs about the role of ethnomathematics in learning numeracy, teachers' beliefs about ethnomathematics-based numeracy teaching, and teachers' beliefs about ethnomathematics-based numeracy learning. In general, teachers who have less than five years of teaching experience or are called new teachers in each dimension are the dimensions of teachers' beliefs about numeracy, teachers' beliefs about the role of ethnomathematics in learning numeracy, teachers' beliefs about ethnomathematics-based numeracy teaching, and teachers' beliefs about ethnomathematics-based numeracy learning shows a tendency towards a semi-realistic-mechanistic view. Furthermore, teachers who have teaching experience of 5 to 10 years are called junior teachers. Each dimension is the dimensions of teachers' beliefs about numeracy, teachers' beliefs about the role of ethnomathematics in learning numeracy, teachers' beliefs about ethnomathematics-based numeracy teaching, and teachers' beliefs about ethnomathematics-based numeracy learning shows a tendency towards a semi-realistic-rechanistic (SRM) view.

Teachers who have teaching experience of more than ten years to 15 years are called semi-senior teachers. The dimensions of the teachers' beliefs about numeracy tend to be a semi-realistic-mechanistic (SRM) view, while on the other three dimensions, namely the teachers' beliefs about the role of ethnomathematics in learning numeracy, teachers' beliefs about ethnomathematics-based numeracy teaching, and teachers' beliefs about ethnomathematics-based numeracy learning show a tendency toward a realistic dominant (RD) view. Then, teachers with more than 15 years of

teaching experience, or called senior teachers, on the dimensions of teachers' beliefs about numeracy and teachers' beliefs about ethnomathematics-based numeracy teaching tend to a semi-realistic-mechanistic (SRM) view, while on the dimension of teachers' beliefs about the role of ethnomathematics in learning numeracy and teachers' beliefs about ethnomathematics-based numeracy learning show a tendency towards a realistic dominant (RD) view.

### 3.2.1. *New teachers (Teachers with less than 5 years of teaching experience)*

**Teachers' beliefs about numeracy.** Regarding the new teacher's beliefs about numeracy, 100% of teachers (47 out of 47) believed that numeracy could help students solve everyday problems in various contexts. More than 91% of teachers (43 out of 47) believe that the main focus in numeracy is the ability to apply mathematics. Furthermore, as many as 96% of teachers (45 out of 47) believe numeracy emphasizes students' skills in implementing mathematical concepts. However, 98% of teachers (46 out of 47) believe that numeracy can help students solve formal math problems. As many as 98% of teachers (46 out of 48) believe that the main focus in numeracy is understanding mathematical concepts. Furthermore, more than 76% of teachers (36 out of 47) believe that numeracy places more emphasis on students' numeracy skills.

**Teachers' beliefs about the role of ethnomathematics in learning numeracy.** The survey results show that the new teacher's beliefs about the role of ethnomathematics in learning numeracy are as follows. As many as 98% of teachers (46 out of 47) believe traditional Javanese games can be used as contexts in learning numeracy. There are 23% of teachers (11 out of 47) who believe that the rules of the game in traditional Javanese games do not contain mathematical concepts. As many as 96% of teachers (45 out of 47) believe that traditional Javanese games in learning numeracy can be used to discover mathematical concepts. However, more than 80% of teachers (38 out of 47) believe that the primary function of traditional Javanese games in learning numeracy is to use it as a distraction so students do not get bored. More than 50% of teachers (26 out of 47) believe that using traditional Javanese games to learn numeracy keeps students focused on their game activities. Less than 23% of teachers (11 out of 47) believed that using traditional Javanese games in learning numeracy keeps students focused on learning numeracy activities.

**Teachers' beliefs about ethnomathematics-based numeracy teaching.** In general, the beliefs of new teachers about ethnomathematics-based numeracy teaching are as follows. As many as 96% of teachers (45 out of 47) believe that in numeracy learning based on traditional Javanese games, teachers provide opportunities for students to discover mathematical concepts independently. As many as 85% of teachers (40 out of 47) have the belief that solving contextual problems in learning numeracy and making sentences/ mathematical models is done by students. However, more than 50% of teachers (25 out of 47) believe that in learning numeracy, the teacher directly shows mathematical concepts related to traditional games. More than 70% of teachers (33 out of 47) believe that to solve contextual problems in learning numeracy, the teacher makes sentences/mathematical models so students do not make mistakes.

**Teachers' beliefs about ethnomathematics-based numeracy learning.** Overall, new teachers' beliefs about ethnomathematics-based numeracy learning are as follows. There are 100% of teachers (47 out of 47) who believe that students' experiences in everyday life can be used to build numeracy skills. More than 93% of teachers (44 out of 47) believe that strengthening numeracy skills can be done across subjects. However, more than 82% of teachers (39 out of 47) believe that counting is the primary skill that must be mastered by students in learning numeracy based on traditional Javanese games. More than 53% of teachers (25 out of 47) believe that strengthening numeracy skills is done through one subject, mathematics.

### 3.2.2. *Junior teachers (Teachers with 5 to 10 years of teaching experience)*

**Teachers' beliefs about numeracy.** Overall, junior teachers' beliefs about numeracy are as follows. 100% of teachers (14 out of 14) believe numeracy can help students solve everyday problems in

various contexts. Furthermore, more than 92% of teachers (13 out of 14) believe that the main focus in numeration is the ability to apply mathematics. 100% of teachers (14 out of 14) believe that numeracy emphasizes students' skills in implementing mathematical concepts. However, 100% of teachers (14 out of 14) believed that numeracy could help students solve formal math problems. There are 100% of teachers (14 out of 14) believe that the main focus in numeracy is understanding mathematical concepts. 64% of teachers (9 out of 14) believe that numeracy emphasizes students' numeracy skills more.

**Teachers' beliefs about the role of ethnomathematics in learning numeracy.** In general, the junior teacher's beliefs about the role of ethnomathematics in learning numeracy are as follows. As many as 86% of teachers (12 out of 14) believe traditional Javanese games can be used as contexts in learning numeracy. As many as 100% of teachers (14 out of 14) believe that traditional Javanese games in learning numeracy can be used to discover mathematical concepts. However, more than 92% of teachers (13 out of 14) believe that the primary function of traditional Javanese games in learning numeracy is to use as a distraction so students do not get bored. As many as 14% of teachers (2 out of 14) believed that the game rules contained in traditional Javanese games did not contain mathematical concepts. More than 78% of teachers (11 out of 14) believe that using traditional Javanese games to learn numeracy keeps students focused on their game activities. Only 14% of teachers (2 out of 14) believed that using traditional Javanese games in learning numeracy keeps students focused on learning numeracy activities.

**Teachers' beliefs about ethnomathematics-based numeracy teaching.** Overall, junior teachers' beliefs about ethnomathematics-based numeracy teaching are as follows. More than 92% of teachers (13 out of 14) believe that in learning numeracy based on traditional Javanese games, teachers provide opportunities for students to discover mathematical concepts independently. More than 92% of teachers (13 out of 14) believe that solving contextual problems in learning numeracy and making sentences/mathematical models is done by students. However, as many as 43% of teachers (6 out of 14) believed that the teacher immediately demonstrated mathematical concepts related to traditional games in learning numeracy. More than 78% of teachers (11 out of 14) believe that to solve contextual problems in learning numeracy, the teacher makes sentences/mathematical models so students do not make mistakes.

**Teachers' beliefs about ethnomathematics-based numeracy learning.** The survey results of junior teachers' beliefs about ethnomathematics-based numeracy learning show that more than 92% of teachers (13 out of 14) believe that students' experiences in everyday life can be used to build numeracy skills. As many as 21% of teachers (3 out of 14) believed that strengthening numeracy skills was done through one subject, mathematics. As many as 100% of teachers (14 out of 14) believe that strengthening numeracy skills can be done through cross-subjects. However, more than 92% of teachers (13 out of 14) believe that counting is the primary skill that must be mastered by students in learning numeracy based on traditional Javanese games.

### 3.2.3. *Semi-senior teachers (Teachers with teaching experience of more than 10 years to 15 years)*

**Teachers' beliefs about numeracy.** In general, the beliefs of semi-senior teachers about numeracy show that more than 91% of teachers (11 out of 12) believe that numeracy can help students solve everyday problems in various contexts. There are 100% of teachers (12 out of 12) believe that the main focus in numeracy is the ability to apply mathematics. However, 100% of teachers (12 out of 12) believed that numeracy could help students solve formal math problems. As many as 75% of teachers (9 out of 12) believe that the main focus in numeracy is understanding mathematical concepts. More than 58% of teachers (7 out of 12) believe that numeracy places more emphasis on students' numeracy skills. Only 25% of teachers (3 out of 12) believe that numeracy emphasizes student skills in implementing mathematical concepts.

**Teachers' beliefs about the role of ethnomathematics in learning numeracy.** Survey data shows that semi-senior teachers' beliefs about the role of ethnomathematics in learning numeracy are as

follows. As many as 100% of teachers (12 out of 12) believed that traditional Javanese games could be used as contexts for learning numeracy. Only 25% of teachers (3 out of 12) believe that the game rules contained in traditional Javanese games do not contain mathematical concepts. As many as 100% of teachers (12 out of 12) believed traditional Javanese games in learning numeracy could be used to discover mathematical concepts. 41% of teachers (5 out of 12) believe that using traditional Javanese games in learning numeracy keeps students focused on their game activities. As many as 75% of teachers (9 out of 12) believed that using traditional Javanese games in learning numeracy keeps students focused on learning numeracy activities. However, as many as 75% of teachers (9 out of 12) believed that the primary function of traditional Javanese games in learning numeracy was used as a distraction so that students would not get bored.

**Teachers' beliefs about ethnomathematics-based numeracy teaching.** In general, the beliefs of semi-senior teachers about ethnomathematics-based numeracy teaching are as follows. Only 25% of teachers (3 out of 12) believe that in learning numeracy, the teacher directly shows mathematical concepts related to traditional games. As many as 100% of teachers (12 out of 12) believed that in learning numeracy based on traditional Javanese games, teachers provide opportunities for students to discover mathematical concepts independently. More than 33% of teachers (4 out of 12) believe that to solve contextual problems in learning numeracy, the teacher makes sentences/mathematical models so students do not make mistakes. More than 91% of teachers (11 out of 12) believe that solving contextual problems in learning numeracy and making sentences/mathematical models is done by students.

**Teachers' beliefs about ethnomathematics-based numeracy learning.** Data from a survey of semi-senior teachers' beliefs about ethnomathematics-based numeracy learning shows that 100% of teachers (12 out of 12) believe that students' experiences in everyday life can be used to build numeracy skills. As many as 25% of teachers (3 out of 12) believed that strengthening numeracy skills was done through one subject, mathematics. As many as 100% of teachers (12 out of 12) believed that strengthening numeracy skills could be done through cross-subjects. However, as many as 75% of teachers (9 out of 12) believe that counting is the primary skill that must be mastered by students in learning numeracy based on traditional Javanese games.

#### 3.2.4. Senior teacher (Teacher with more than 15 years of teaching experience)

**Teachers' beliefs about numeracy.** The survey data shows that senior teachers' beliefs about numeracy are as follows. 100% of teachers (78 out of 78) believe numeracy can help students solve everyday problems in various contexts. There, 88% of teachers (69 out of 78) believe that the main focus in numeracy is the ability to apply mathematics. More than 97% of teachers (76 out of 78) believe that numeracy emphasizes students' skills in implementing mathematical concepts. However, more than 97% of teachers (76 out of 78) believe numeracy can help students solve formal math problems. As many as 96% of teachers (75 out of 78) believe that the main focus in numeracy is understanding mathematical concepts. As many as 79% of teachers (62 out of 78) believe that numeracy places more emphasis on students' numeracy skills.

**Teachers' beliefs about the role of ethnomathematics in learning numeracy.** Overall, senior teachers' beliefs about the role of ethnomathematics in learning numeracy show that as many as 92% of teachers (72 out of 78) believe that traditional Javanese games can be used as contexts in learning numeracy. Only 11% of teachers (9 out of 78) believed that the game rules contained in traditional Javanese games did not contain mathematical concepts. As many as 95% of teachers (74 out of 78) believe that traditional Javanese games in learning numeracy can be used to discover mathematical concepts. However, as many as 82% of teachers (64 out of 78) believe that the primary function of traditional Javanese games in learning numeracy is to use it as a distraction so students do not get bored. As many as 54% of teachers (42 out of 78) believe that using traditional Javanese games in learning numeracy keeps students focused on their game activities. Only 11% of

teachers (9 out of 78) believed that using traditional Javanese games in learning numeracy keeps students focused on learning numeracy activities.

**Teachers' beliefs about ethnomathematics-based numeracy teaching.** In general, the survey data shows that the beliefs of senior teachers about ethnomathematics-based numeracy teaching are based on ethnomathematics as follows. As many as 88% of teachers (69 out of 78) believe that in numeracy learning based on traditional Javanese games, teachers provide opportunities for students to discover mathematical concepts independently. As many as 69% of teachers (54 out of 78) have the belief that solving contextual problems in learning numeracy and making sentences/mathematical models is done by students. However, as many as 53% of teachers (41 out of 78) believed that the teacher immediately demonstrated mathematical concepts related to traditional games in learning numeracy. As many as 74% of teachers (58 out of 78) believe that to solve contextual problems in learning numeracy, the teacher makes sentences/mathematical models so students do not make mistakes.

**Teachers' beliefs about ethnomathematics-based numeracy learning.** In general, the beliefs of senior teachers about ethnomathematics-based numeracy learning show that more than 98% of teachers (77 out of 78) believe that students' experiences in everyday life can be used to build numeracy skills. As many as 35% of teachers (27 out of 78) believe that strengthening numeracy skills is done through one subject, mathematics. More than 98% of teachers (77 out of 78) believe that strengthening numeracy skills can be done through cross-subjects. However, as many as 87% of teachers (68 out of 78) believe that counting is the primary skill that must be mastered by students in learning numeracy based on traditional Javanese games. The characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning based on teaching experience are determined based on the most significant percentage of respondents. Characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning based on new teachers' teaching experience are presented in Table 9.

According to Table 9, teachers' belief in developing students' numeracy skills through ethnomathematics-based numeracy learning based on the teaching experience of new teachers is in the SRM category. Characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning based on junior teachers' teaching experience are presented in Table 10. The idea of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning, as informed by the teaching experiences of junior teachers, falls under the scope of the SRM category. Characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning based on semi-senior teacher's teaching experience are presented in Table 11. Teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning based on the teaching experience of semi-senior teachers is in the RD category. Finally, characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning based on senior teacher's teaching experience are presented in Table 12. Teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning based on the teaching experience of senior teachers is in the SRM and RD categories.

#### 4. Discussion

Generally, the teachers' belief in developing students' numeracy skills through ethnomathematics-based numeracy learning is divided into four dimensions. The dimensions of teachers' beliefs about numeracy, teachers' beliefs about the role of ethnomathematics in learning numeracy, and teachers' beliefs about ethnomathematics-based numeracy teaching are SRM categories. Meanwhile, the DR categories are in the dimensions of the teachers' beliefs about ethnomathematics-based numeracy learning.



**Table 9**  
*Characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning based on new teacher's teaching experience*

Category	M		MD		SRM		RD		R		Conclusion
	f	(%)	f	(%)	f	(%)	f	(%)	f	(%)	
Teachers' beliefs about...											
numeracy	0	0	1	2.13	37	78.72	9	19.15	0	0	SRM
the role of ethnomathematics in learning numeracy	0	0	3	6.38	23	48.94	21	44.68	0	0	SRM
ethnomathematics-based numeracy teaching	1	2.13	2	4.26	21	44.68	15	31.91	8	17.02	SRM
ethnomathematics-based numeracy learning	0	0	2	4.26	20	42.55	19	40.43	6	12.77	SRM

**Table 10**  
*Characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning based on junior teacher's teaching experience*

Category	M		MD		SRM		RD		R		Conclusion
	f	(%)	f	(%)	f	(%)	f	(%)	f	(%)	
Teachers' beliefs about...											
numeracy	0	0	1	7.14	9	64.29	4	28.57	0	0	SRM
the role of ethnomathematics in learning numeracy	0	0	1	7.14	11	78.57	2	14.29	0	0	SRM
ethnomathematics-based numeracy teaching	0	0	0	0	8	57.14	3	21.43	3	21.43	SRM
ethnomathematics-based numeracy learning	0	0	0	0	3	21.43	11	78.57	0	0	SRM

**Table 11**  
*Characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning based on semi-senior teacher's teaching experience*

Category	M		MD		SRM		RD		R		Conclusion
	f	(%)	f	(%)	f	(%)	f	(%)	f	(%)	
Teachers' beliefs about...											
numeracy	0	0	1	8.33	6	50	5	41.67	0	0	SRM
the role of ethnomathematics in learning numeracy	0	0	0	0	3	25	9	75	0	0	RD
ethnomathematics-based numeracy teaching	0	0	0	0	1	8.33	6	50	5	41.67	RD
ethnomathematics-based numeracy learning	0	0	0	0	3	25	7	58.33	2	16.67	RD

**Table 12**  
*Characteristics of teachers' beliefs in developing students' numeracy skills through ethnomathematics-based numeracy learning based on semi-senior teacher's teaching experience*

Category	M		MD		SRM		RD		R		Conclusion
	f	(%)	f	(%)	f	(%)	f	(%)	f	(%)	
Teachers' beliefs about...											
numeracy	0	0	4	5.13	63	80.77	11	14.1	0	0	SRM
the role of ethnomathematics in learning numeracy	0	0	6	7.69	34	43.59	38	48.72	0	0	RD
ethnomathematics-based numeracy teaching	2	2.56	10	12.82	40	51.28	13	16.67	13	16.67	SRM
ethnomathematics-based numeracy learning	0	0	1	1.28	25	32.05	44	56.41	8	10.26	RD

The survey data about teachers' beliefs is categorized based on teaching experience. Specifically, the teachers' beliefs are classified into four distinct categories: new teachers (those with less than five years of teaching experience), junior teachers (those with 5 to 10 years of teaching experience), experienced teachers (those with more than ten years of teaching experience); senior teachers are defined as those who have been teaching for a period ranging from 10 to 15 years. Additionally, teachers with over 15 years of teaching experience are considered senior teachers. According to the data, there is a distinction between teachers with less than five years of teaching experience and those with 5 to 10 years of teaching experience in their beliefs about numeracy, the role of ethnomathematics in numeracy learning, ethnomathematics-based numeracy teaching, and ethnomathematics-based numeracy learning. These beliefs exhibit SRM categories. According to the data, evidence suggests that teachers' ideas regarding numeracy exhibit semi-realistic-mechanistic attributes, with distinctions observed between teachers with 10 to 15 years of teaching experience and those with over 15 years of teaching experience. In education, there is a prevailing trend where teachers hold certain attitudes regarding the significance of ethnomathematics in acquiring numeracy skills. These beliefs also extend to the importance of ethnomathematics in shaping numeracy learning experiences. According to the data, teachers with teaching experience ranging from 10 to 15 years are in the RD category regarding ethnomathematics-based numeracy learning. In contrast, teachers with more than 15 years of teaching experience tend to be in the SRM category.

Generally, the teachers' belief in developing students' numeracy skills through ethnomathematics-based numeracy learning is in the SRM category, including the teacher's belief based on his teaching experience. Based on data on teachers' beliefs about numeracy, teachers tend to have difficulty differentiating between numeracy and mathematics. Teachers think that numeracy and mathematics are the same thing. The survey results prove that teachers expressed that the main emphasis in numeracy is understanding concepts and developing numeracy skills. However, teachers also believe that numeracy emphasizes students' skills in implementing mathematical concepts into real-life contexts. This perspective presents a contradiction, as numeracy encompasses the capacity to analyze and interpret quantitative data in diverse formats such as graphs, tables, and charts. By leveraging the outcomes of such analyses, individuals can engage in prediction and decision-making processes (Han et al., 2017). Another opinion suggests that numeracy is the ability to access, use, and interpret mathematical information (Lechner et al., 2021).

Teachers' beliefs about numeracy indicate that numeracy is applying mathematical concepts to problem contexts. However, teachers also believe that numeracy can help students solve math problems studied at school, meaning that only formal problems are given by the teacher in the form of questions to solve. Teachers tend to believe that the main target of numeracy relates to students' ability to understand mathematical concepts or stop at the understanding level. The teacher believes that the main focus in numeracy is students' skills in doing calculations. This teachers' beliefs is different from the definition of numeracy, which shows that numeracy is the skill of developing logical thinking and reasoning strategies in daily activities in real-life contexts across subjects (Getenet, 2022). Numeracy skills include understanding mathematical concepts and applying those principles in practical situations. Numeracy aptitude extends beyond mere computation proficiency, encompassing the capacity to address real-life challenges that necessitate quantitative reasoning and thinking processes. Mathematical reasoning encompasses higher-order thinking skills (HOTS) and serves as a means of problem-solving in various real-life scenarios, enabling individuals to derive logical conclusions (Hidayat et al., 2022; Palengka & Juniati, 2022).

Furthermore, data on teachers' beliefs about ethnomathematics shows that teacher understanding of the ethnomathematics role of traditional Javanese games in learning numeracy tends to be used as entertainment or has a decorative meaning only. The role of ethnomathematics in traditional Javanese games is to discover mathematical concepts or have more essential meanings. In general, the teachers' beliefs about ethnomathematics show that the teacher needs to

be sure that in traditional Javanese games, there are mathematical concepts in the game rules. The study results show that in traditional games, many aspects strongly correlate with mathematical concepts (Jabar et al., 2022). So, the presence of traditional Javanese games in learning numeracy will only make students focus on their game activities, and the primary purpose of providing the context of traditional Javanese games at the beginning of learning to invite students to discover mathematical concepts will not be achieved. Some research results show that traditional games can be used as a solution for teachers so that learning mathematics becomes easy and flexible to discover mathematical concepts (Supriadi, 2022). Traditional games can be used to stimulate students' interest in learning numeracy (Godfrey & Mtebe, 2018).

In general, teachers dominate numeracy learning. Teachers actively teach numeracy rather than as facilitators who allow students to develop their knowledge. Several studies suggest that instructional practice can help students learn math (De Corte, E., Mason, L., Depaepe, F., & Verschaffel, 2011). Teachers must develop student-centered learning environments to encourage activity and independence (Baeten et al., 2010). Math group conversations can also reveal students' thinking and reasoning (Thanheiser & Melhuish, 2023).

In general, teachers believe students may learn numeracy from their experiences. From the perspective that mathematics is an activity of people, a societal occurrence, and an integral component of human civilization that has evolved and can solely be comprehended within a social framework, mathematics consistently serves as a tool or system of communication to interpret the world's complexities. The teacher's numeracy knowledge extends beyond mathematics to other topics. Thus, cross-subjects improve students' numeracy skills. Numeracy develops logic, thinking, and reasoning in daily life across subjects (Getenet, 2022). Most teachers remain mechanical, focusing on students' numeracy skills in problem-solving (Geary et al., 2013). Numeracy is not merely the capacity to calculate but also to solve problems.

Teachers who hold positive beliefs, namely in the RD and R categories, about implementing and processing ethnomathematics-based numeracy learning have the potential to enhance students' numeracy skills. Likewise, teachers' beliefs based on specific teaching experiences in the RD and R categories regarding the ethnomathematics-based numeracy learning process have a great opportunity to improve students' numeracy skills. This assertion is substantiated by multiple research findings that demonstrate the impact of teachers' beliefs on the objectives to be attained. Teachers' beliefs support developing students' abilities through classroom learning (Diamond, 2019). The successful outcome of implementing creativity into the educational context is largely contingent upon the beliefs held by teachers (Bereczki & Kárpáti, 2018). Teaching experience and teachers' beliefs can influence the implementation of teaching in the classroom (Murugaiah, 2023). A conceptual model showing ethnomathematics-based numeracy learning, teachers' beliefs, and students' numeracy skills is presented in Figure 1.

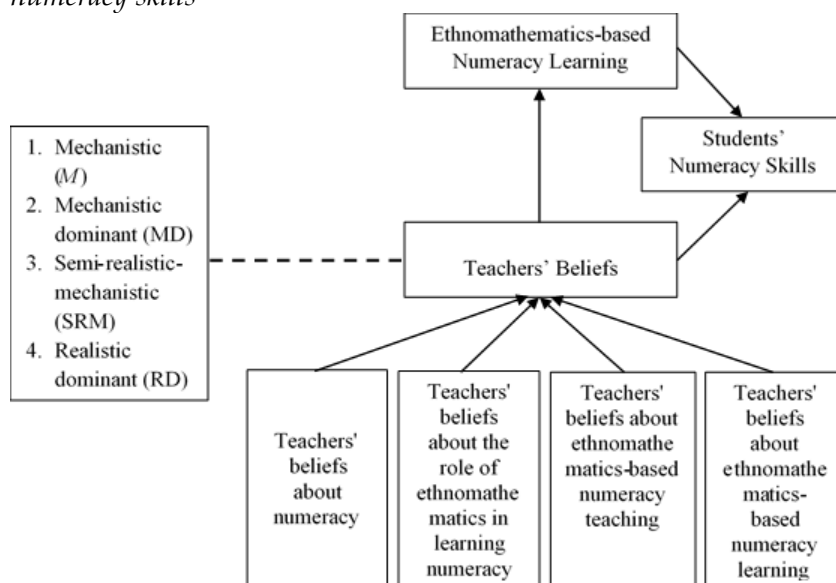
## 5. Conclusion

This study found that most teachers believed in developing students' numeracy skills through ethnomathematics-based numeracy learning in the SRM category, including teachers' beliefs based on their teaching experience. The characteristics of the teachers' beliefs in the SRM category appear when on the dimensions of the teachers' beliefs about numeracy, the teacher believes that numeracy can help students solve everyday life problems in various contexts, the main focus in numeracy is the ability to apply mathematics, numeracy is more emphasizes students' skills in implementing mathematical concepts, numeracy can assist students in solving formal mathematical problems, the main focus in numeracy is understanding mathematical concepts, and numeracy places more emphasis on students' skills in counting.

On the dimensions of the teachers' beliefs about the role of ethnomathematics in learning numeracy, the teacher believes that traditional Javanese games can be used as contexts in learning numeracy, the teacher is not sure that the rules of the game contained in traditional Javanese

Figure 1

Conceptual model showing ethnomathematics-based numeracy learning, teachers' beliefs, and students' numeracy skills



games do not contain mathematical concepts, traditional Javanese games in learning numeracy can be used as a means of discovering mathematical concepts, the primary function of traditional Javanese games in learning numeracy is used as a distraction so that students do not get bored, the use of traditional Javanese games in learning numeracy keeps students focused on their game activities, and teachers are not sure that the use of traditional games Java in learning numeracy keeps students focused on learning numeracy activities.

In the dimension of teachers' beliefs about ethnomathematics-based numeracy teaching, teachers believe in numeracy learning based on traditional Javanese games as follows. Teachers provide opportunities for students to discover mathematical concepts and solve contextual problems in learning numeracy by creating sentences/mathematical models. The numeracy carried out by the teacher directly shows mathematical concepts related to traditional games. In solving contextual problems in learning numeracy, teachers create mathematical sentences/models so students can avoid mistakes.

In the dimensions of teachers' beliefs about ethnomathematics-based numeracy learning, teachers believe that students' experiences in everyday life can be used to build numeracy skills, strengthening numeracy skills can be done through cross-subjects, counting is the primary skill that must be mastered by students in learning numeracy based on traditional Javanese games and strengthening numeracy skills through one subject, namely mathematics. Teachers who have positive beliefs, specifically within the RD and R categories, towards the implementation of ethnomathematics-based numeracy learning can develop students' numeracy skills.

## 6. Limitations

This research is limited by teachers' beliefs in enhancing students' numeracy skills through ethnomathematics-based numeracy learning, which each teacher owns. Only the teacher's questionnaire responses were examined in this study. Further research is needed to examine teachers' beliefs on ethnomathematics-based numeracy learning, specifically its use in numeracy learning.

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**Data availability:** The data that support the findings of this study are available from the corresponding author upon reasonable request.

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**Ethics declaration:** At the time of this research, Yogyakarta State University and Purworejo Muhammadiyah University did not have a protocol. Participants gave informed consent. Data is protected and used only for research. Participants cannot be identified from the data.

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